SST, Eddies, and Pattern Recognition in ECCO2

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in cooperation with
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Motivation

- Availability of SST and SSH observations permits detection and tracking of eddies
- Satellite-altimetry-derived SSH can provide estimates of eddy propagation velocity, the spatial resolution of these estimates is limited
- SST data products with much higher spatial resolution and with longer time spans than the altimetric records are available (GHRSST) and can potentially be used for eddy detection

Goals and Approach

- Goal of this project is to determine to which extent and under what conditions SST-derived eddy positions and trajectories match SSH and surface-velocity results
- Use of ECCO2 as a “test bed” to investigate these conditions
- Attribute some of the observed SST-variability in GHRSST data products to eddy advection processes (future work)

Eddy detection

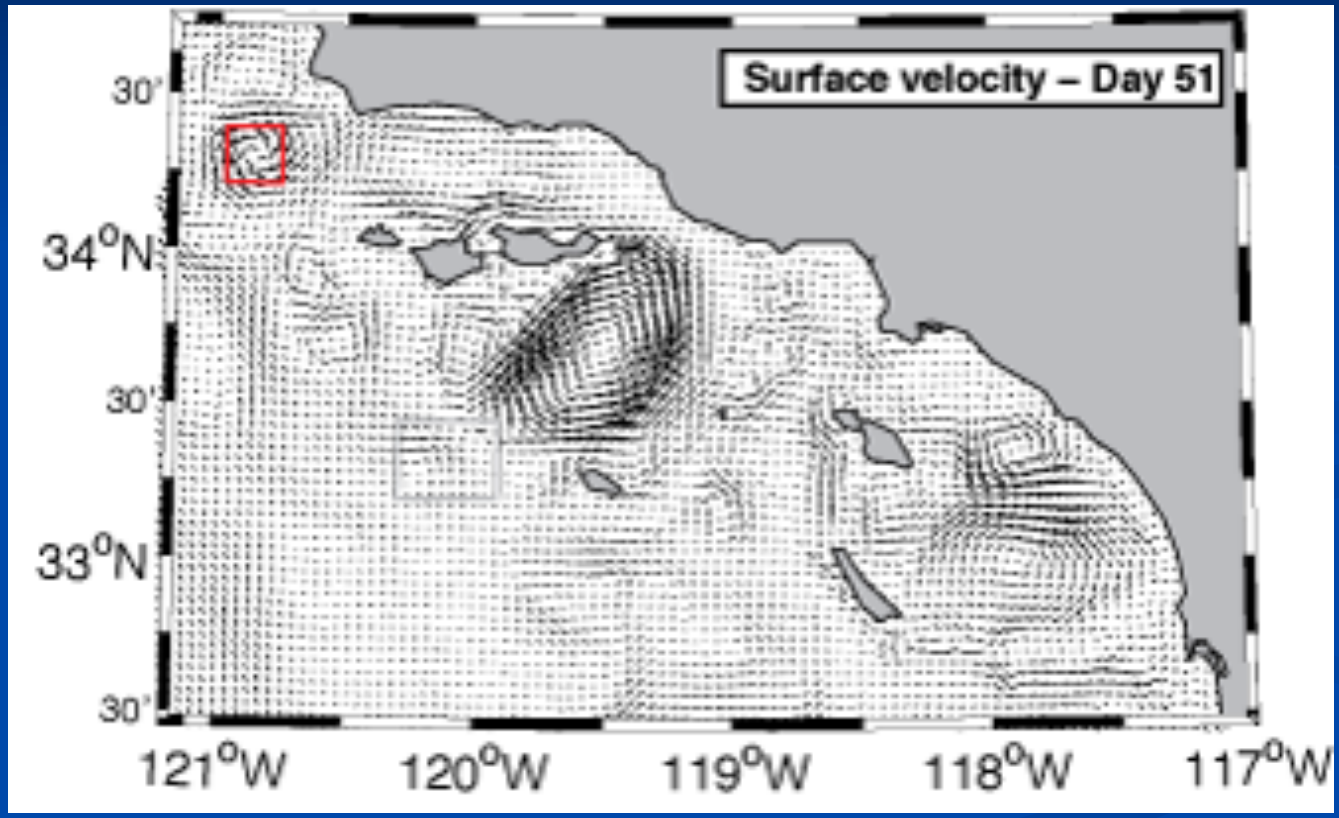
Eddy detection has so far mostly been done:

- either manually, or
- based on the distribution of physical parameters (usually computed from velocity derivatives)
- based on the geometry of velocity streamlines around minima and maxima of sea level anomalies

New automated geometrical eddy detection method by Nencioli et al. (JAOT, in review):

- Derivation of four constraints to characterize the spatial eddy distribution from general features associated with velocity fields
- Grid points that satisfy these four constraints are detected as eddy centers
- Eddy sizes are computed from closed streamlines
- Eddy tracks are retrieved from comparison of successive time steps

Four constraints

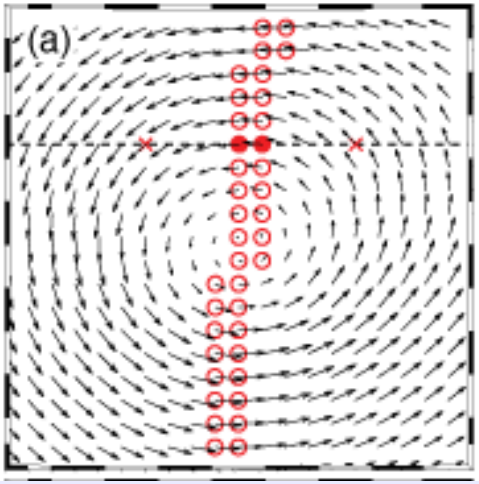


Nencioli et al., 2009, in review

Four constraints

1. Along E-W section, v has to reverse in sign across the eddy center, and its magnitude has to increase away from it

Four constraints



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Four constraints

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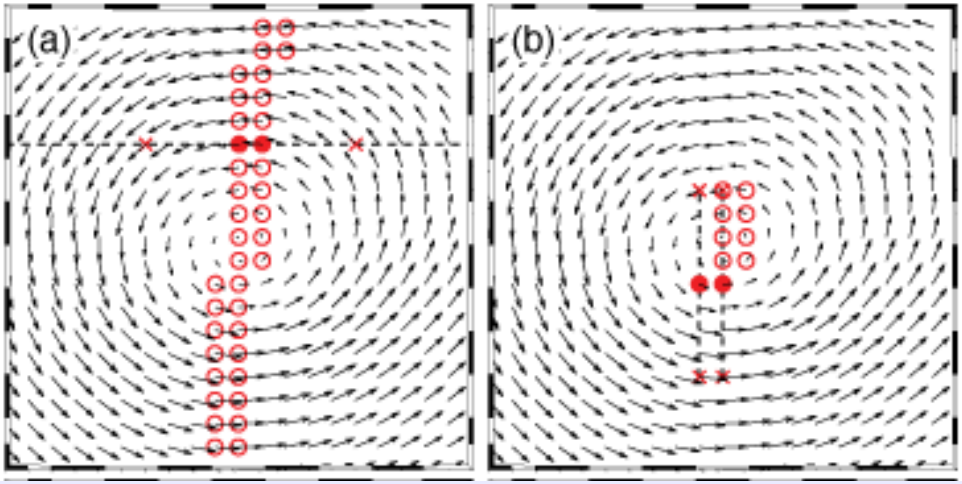
2. Along N-S section, u has to reverse in sign across the eddy center, and its magnitude has to increase away from it; the sense of rotation has to be the same as for v

Four constraints



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3. Velocity magnitude has a local min. at the eddy center

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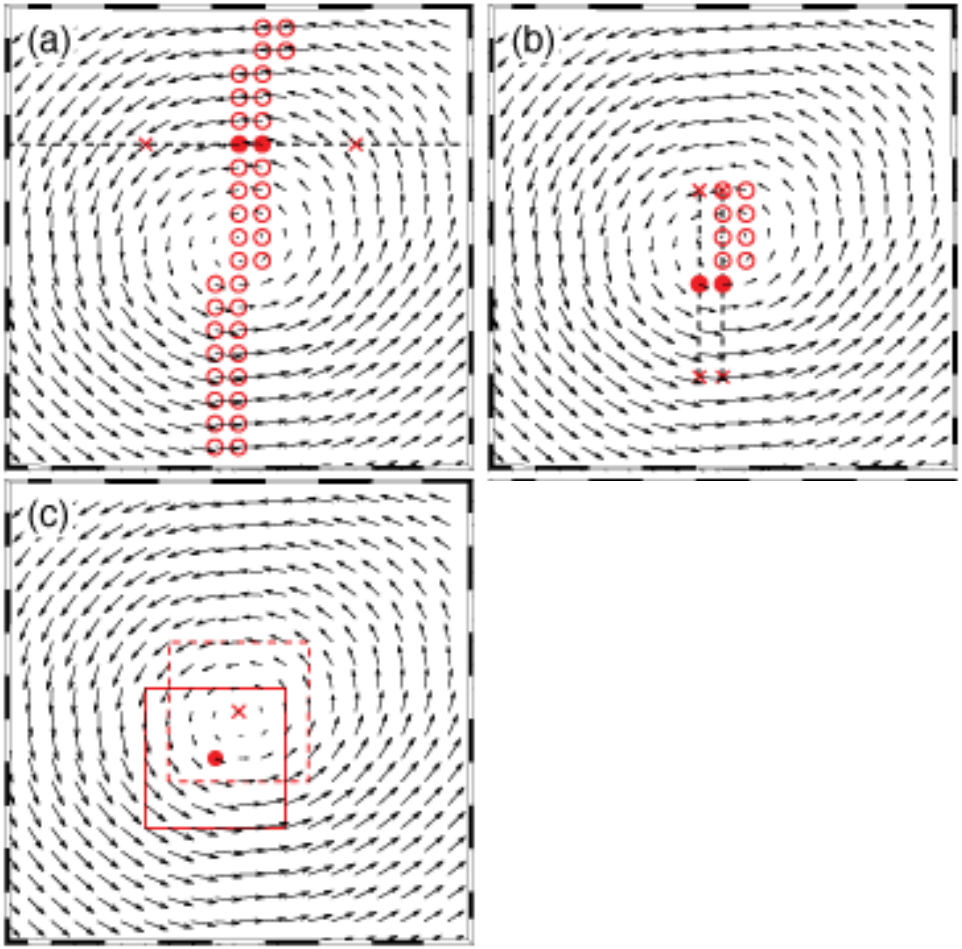

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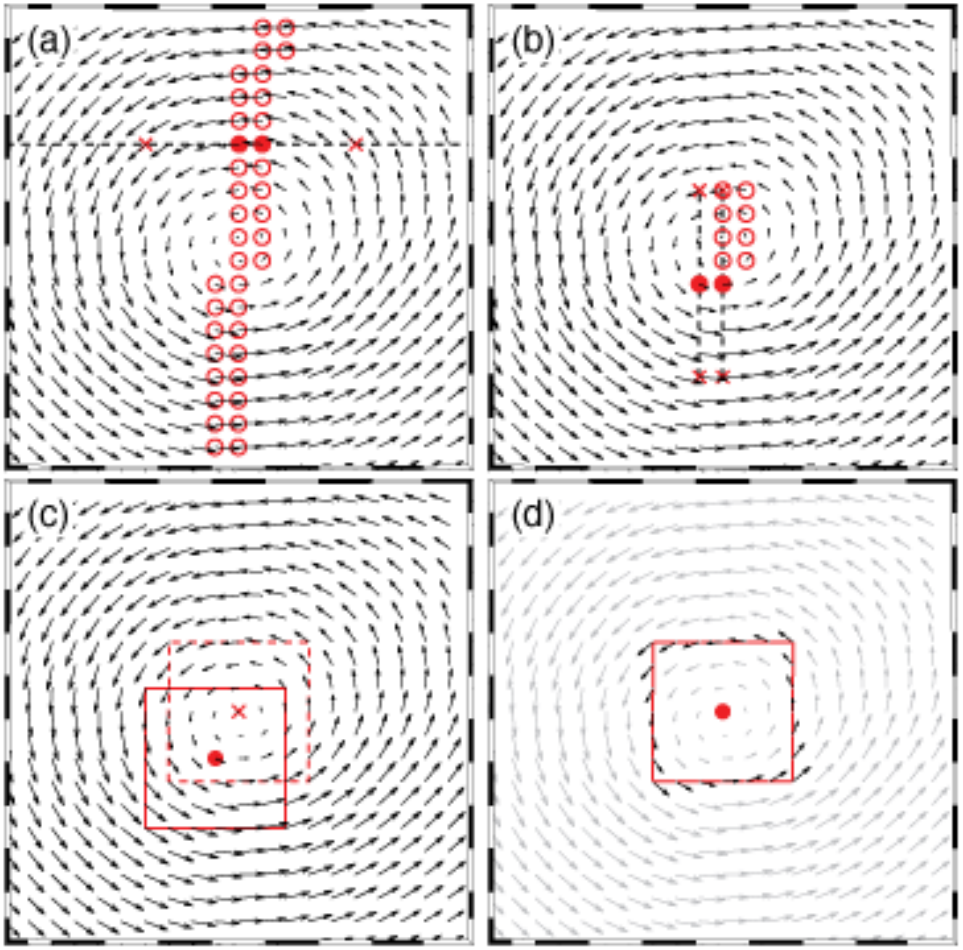
3. Velocity magnitude has a local min. at the eddy center
4. Around the eddy center, the directions of the velocity vectors have to change with constant sense of rotation, and the directions of two neighboring velocity vectors have to lay within the same, or two adjacent quadrants (the four quadrants are defined by the north-south and west-east axes: E-N, N-W, W-S, S-E

Four constraints



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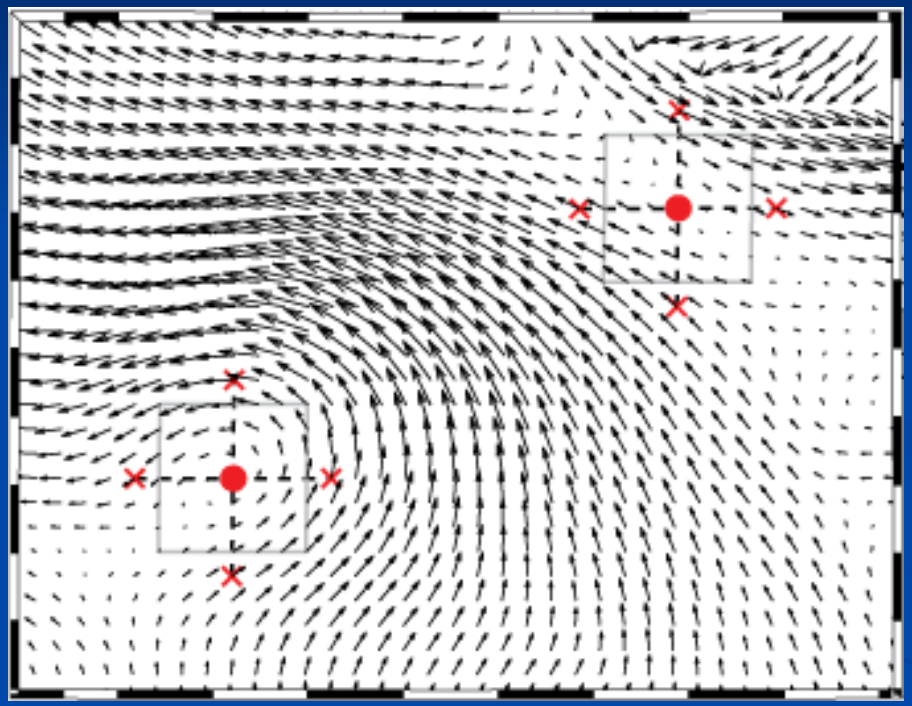

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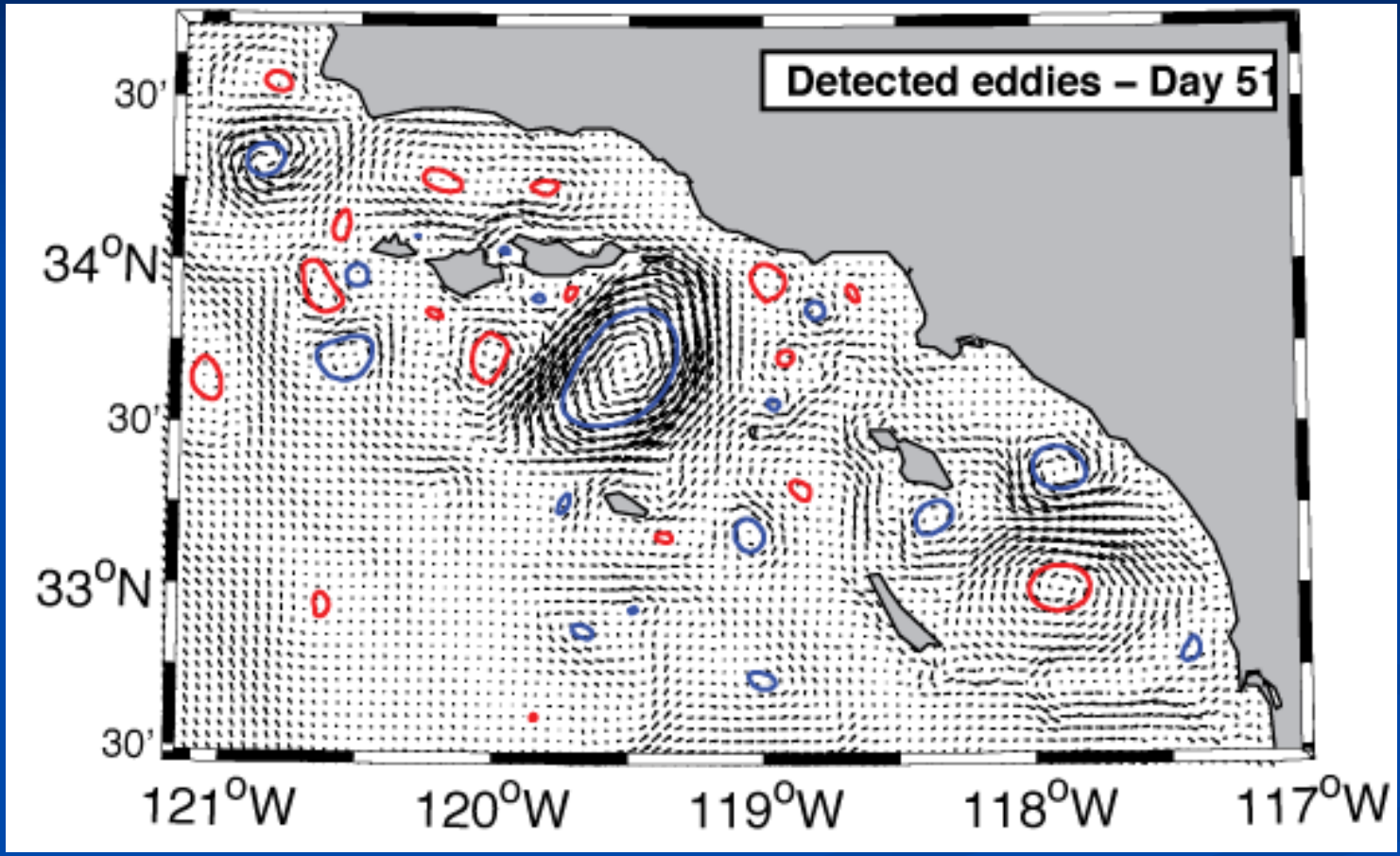
Detected eddies (ROMS)



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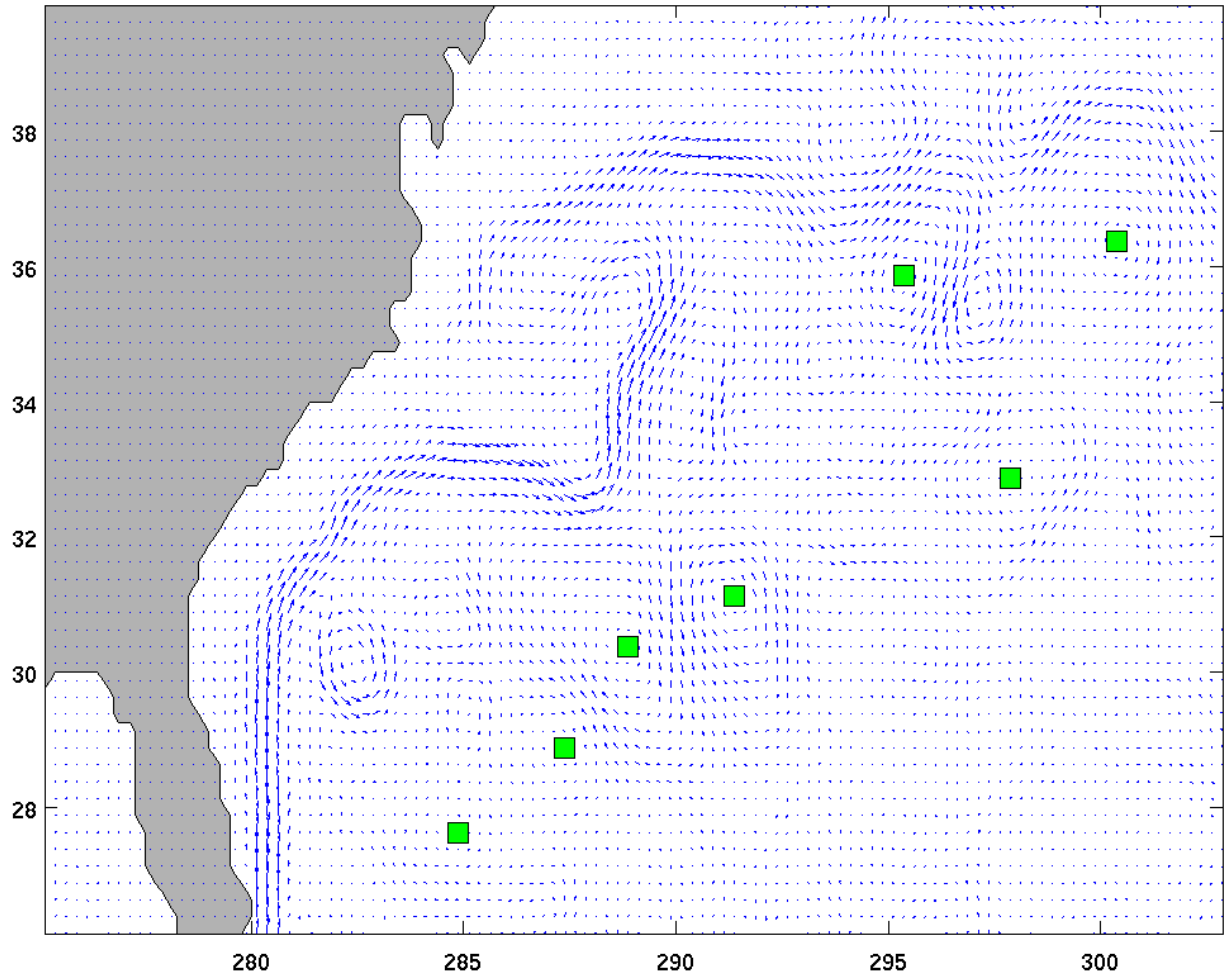
First Results: ECCO Eddy Centers



from UV

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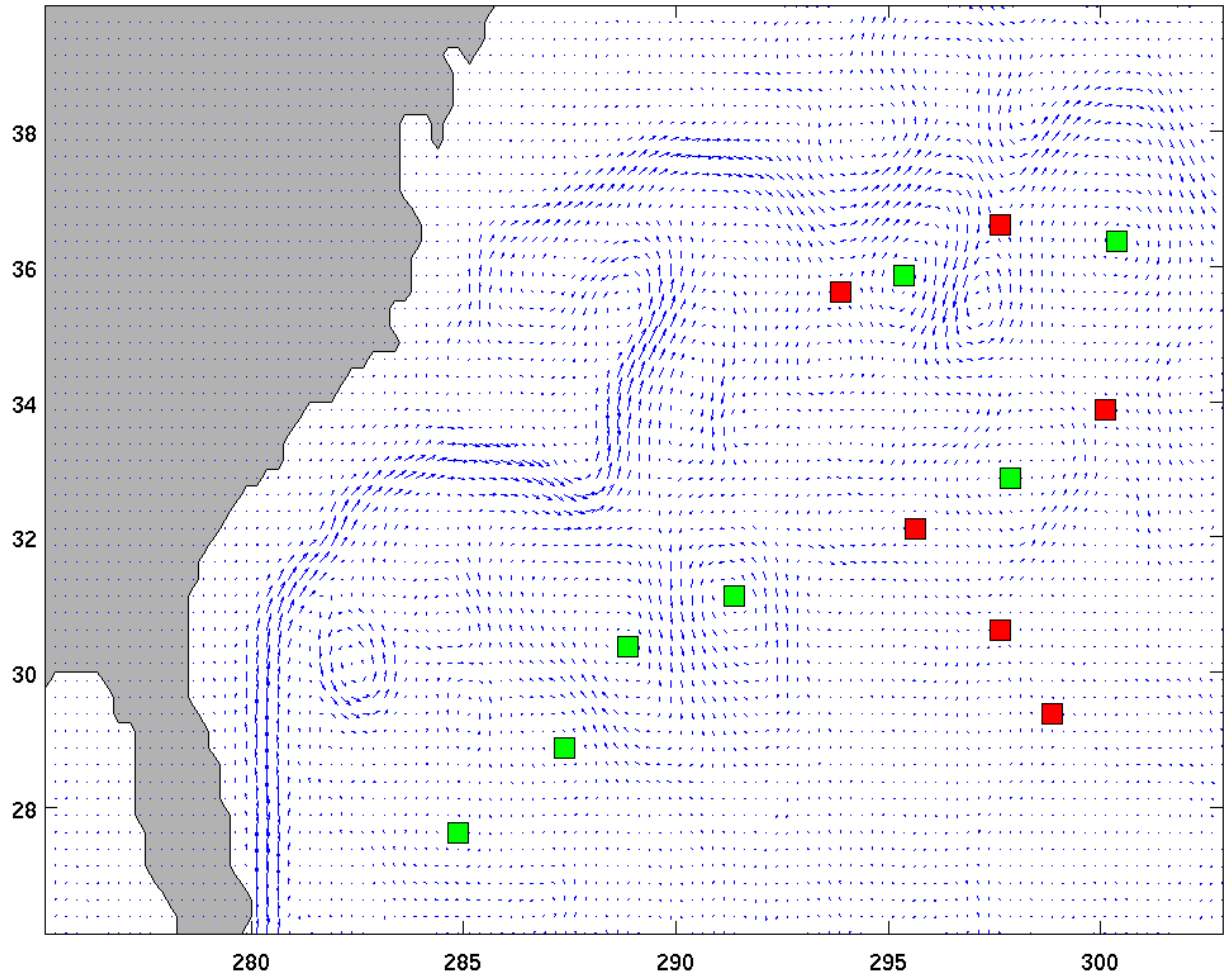
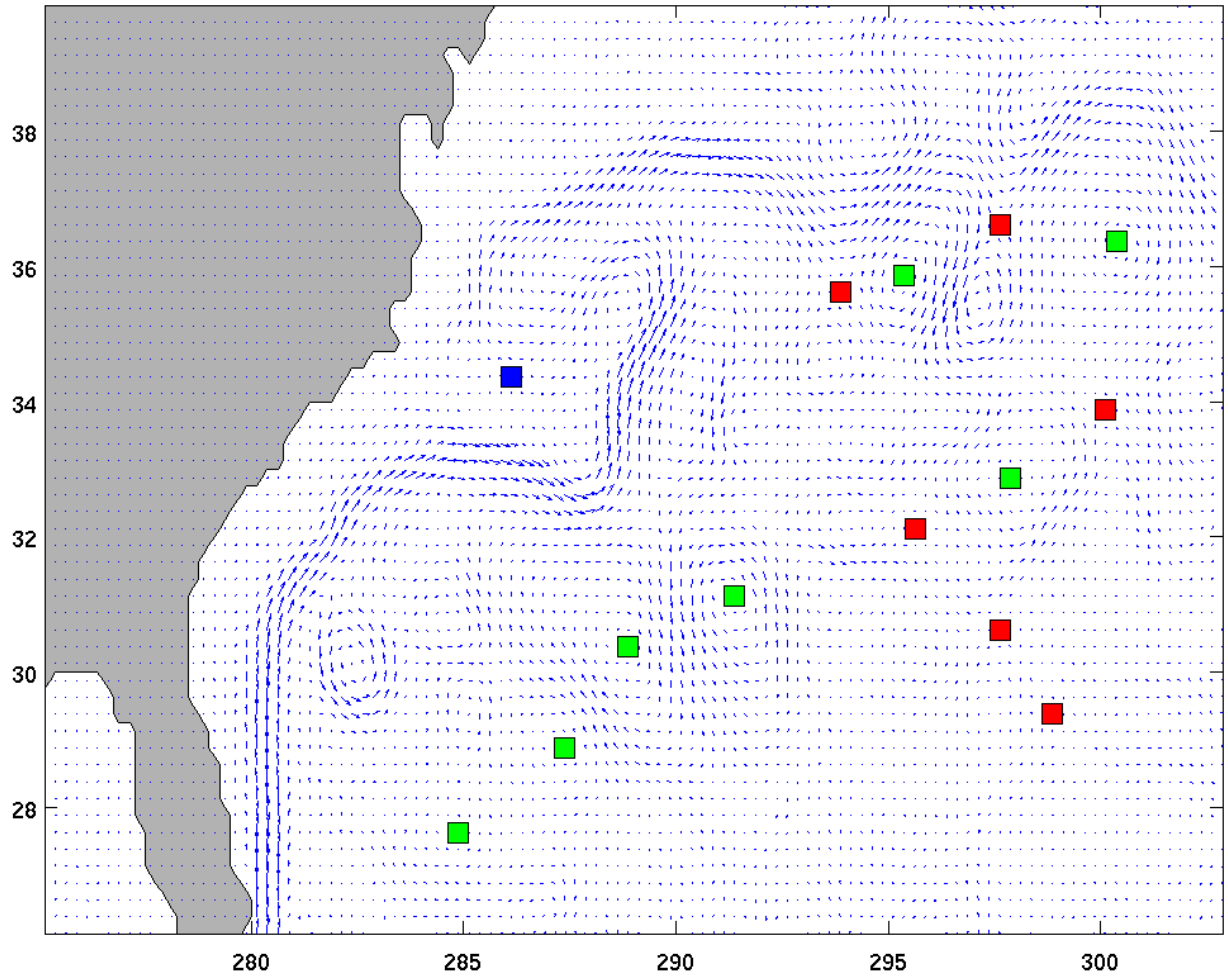


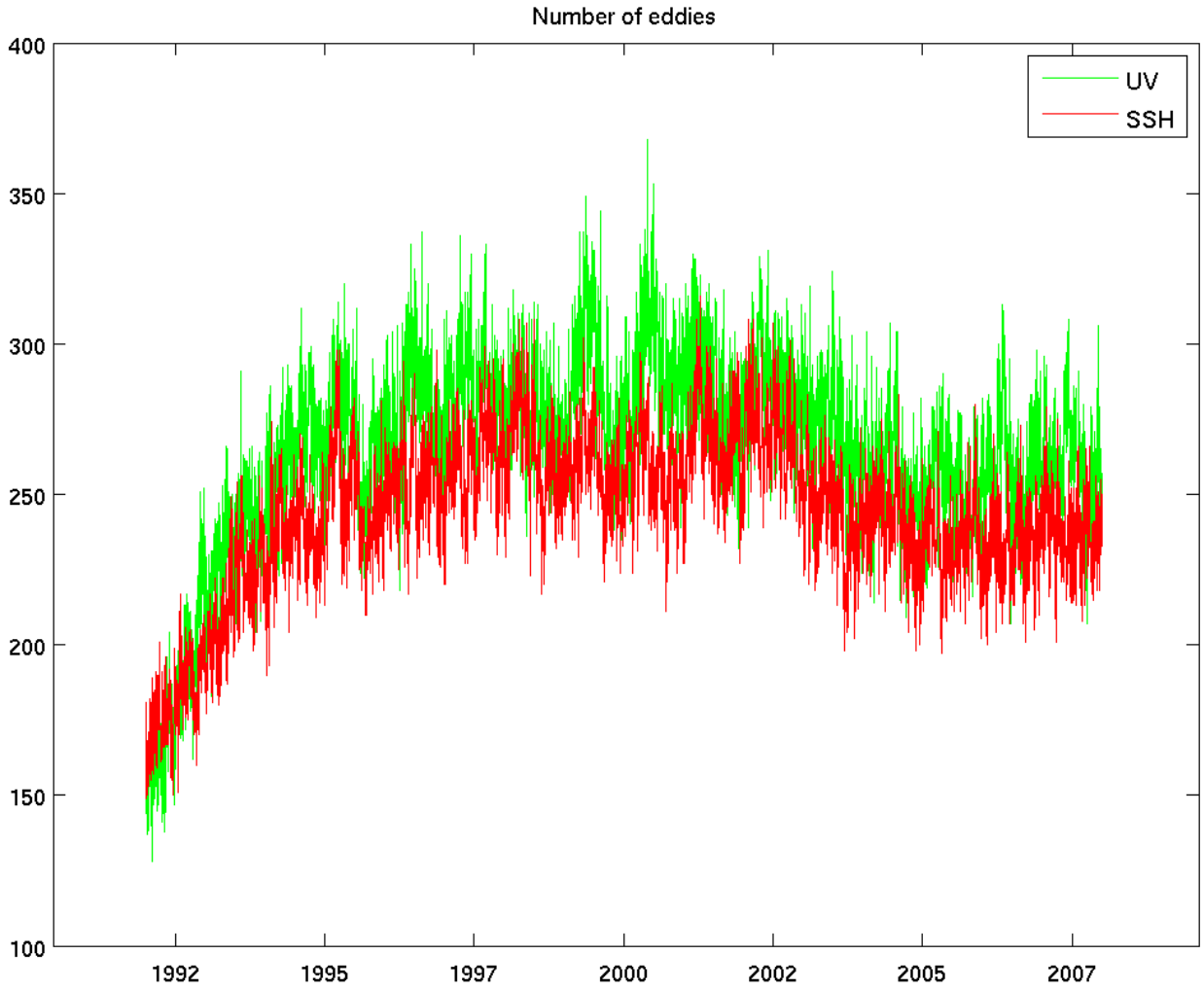
from UV, SSH,

First Results: ECCO Eddy Centers



from UV, SSH, SST

First Results: Number of eddies



Summary

- New eddy detection method captures most (but not all) eddies from surface velocity fields
- SSH fields yield similar amount of eddies, but positions differ
- SST fields (for first ECCO2 results) need improvements (tuning of algorithm)